CLAIMS

1. A plasma doping method for doping impurities into a sample or into a film on the surface of the sample, comprising:

a first step of placing said sample on a sample electrode in a vacuum chamber;

a second step of evacuating said vacuum chamber with supplying a doping material gas into said vacuum chamber, and supplying a high frequency electric power to a plasma source with controlling the pressure of said vacuum chamber at a first pressure so as to generate plasma in said vacuum chamber; and

a third step of controlling the pressure of said vacuum chamber into a second pressure lower than said first pressure with maintaining the generation of the plasma.

2. A plasma doping method for doping impurities into a sample or into a film on the surface of the sample, comprising:

a first step of placing said sample on a sample electrode in a vacuum chamber;

a second step of evacuating said vacuum chamber with supplying a gas containing an inert gas other than helium into said vacuum chamber, and

supplying a high frequency electric power to a plasma source with controlling the pressure of said vacuum chamber at a first pressure so as to generate plasma in said vacuum chamber; and

a third step of evacuating said vacuum chamber with supplying a gas containing helium into said vacuum chamber with maintaining the generation of the plasma, so as to control the pressure of said vacuum chamber into a second pressure.

3. A plasma doping method for doping impurities into a sample or into a film on the surface of the sample, comprising:

a first step of placing said sample on a sample electrode in a vacuum chamber;

a second step of evacuating said vacuum chamber with supplying a gas into said vacuum chamber, and supplying a high frequency electric power to a plasma source with controlling the pressure of said vacuum chamber at a first pressure so as to generate plasma in said vacuum chamber; and

a third step of controlling the pressure of said vacuum chamber into a second pressure different from said first pressure with maintaining the generation of the plasma, and supplying a high frequency electric power larger than the high

frequency electric power in said second step to the plasma source.

4. A plasma doping method for doping impurities into a sample or into a film on the surface of the sample, comprising:

a first step of placing said sample on a sample electrode in a vacuum chamber;

a second step of evacuating said vacuum chamber with supplying a gas not containing a doping material gas into said vacuum chamber, and supplying a high frequency electric power to a plasma source with controlling the pressure of said vacuum chamber at a first pressure so as to generate plasma in said vacuum chamber; and

a third step of evacuating said vacuum chamber with supplying a gas containing a doping material gas into said vacuum chamber with maintaining the generation of the plasma, so as to control the pressure of said vacuum chamber into a second pressure different from said first pressure.

5. A plasma doping method, wherein a vacuum chamber comprising a plasma generating apparatus is evacuated with supplying a gas into said vacuum chamber, and a high frequency electric power is

supplied to the plasma generating apparatus via a matching circuit of plasma generating apparatus comprising toroidal cores serving as two variable impedance elements, whereby plasma is generated in said vacuum chamber, and impurities are doped into a sample placed on a sample electrode in said vacuum chamber or into a film on the surface of the sample, characterized in that

at least one of control parameters, such as gas species, gas flow rate, pressure and high frequency electric power, is changed with maintaining the generation of plasma.

6. A plasma doping method, wherein a vacuum chamber comprising a plasma generating apparatus is evacuated with supplying a gas into said vacuum chamber, and a high frequency electric power is supplied to the plasma generating apparatus via a matching circuit of plasma generating apparatus, whereby plasma is generated in said vacuum chamber, and impurities are doped into a sample placed on a sample electrode in the vacuum chamber or into a film on the surface of the sample, characterized in that

at least one of control parameters of gas species, gas flow rate, pressure and high frequency electric power is changed gradually in 1 second

through 5 seconds with maintaining the generation of plasma.

7. A plasma doping method, wherein a vacuum chamber comprising a plasma generating apparatus is evacuated with supplying a gas into said vacuum chamber, a high frequency electric power is supplied to said plasma generating apparatus so as to generate plasma in said vacuum chamber, and a high frequency electric power is supplied to a sample electrode on which a sample is placed in said vacuum chamber, whereby impurities are doped into said sample placed on said sample electrode in said vacuum chamber or into a film on the surface of said sample, characterized in that

when the forward power of the high frequency electric power supplied to said plasma generating apparatus or said sample electrode is denoted by Pf and when the reflected power thereof is denoted by Pr, the power difference Pf-Pr is sampled in every interval of 1 millisecond through 100 milliseconds, and when the integration of the power difference Pf-Pr with respect to time reaches a predetermined value, the supply of said high frequency electric power is stopped.

8. A plasma doping method in accordance with claim 7, wherein

at least one of control parameters, such as gas species, gas flow rate, pressure and high frequency electric power, is changed during the process of plasma doping with maintaining the generation of plasma.

9. A plasma doping apparatus comprising:

a vacuum chamber;

a gas supplying apparatus for supplying a gas into said vacuum chamber;

an evacuating apparatus for evacuating said vacuum chamber;

a regulating valve for controlling the pressure of said vacuum chamber into a predetermined value;

a sample electrode for placing a sample in said vacuum chamber;

a plasma generating apparatus;

a matching circuit for plasma generating apparatus comprising toroidal cores serving as two variable impedance elements; and

a high frequency power supply for supplying a high frequency electric power to said plasma

generating apparatus via said matching circuit for plasma generating apparatus.

10. A plasma doping apparatus comprising:

a vacuum chamber;

a gas supplying apparatus for supplying a gas into said vacuum chamber;

an evacuating apparatus for evacuating said vacuum chamber;

a regulating valve for controlling the pressure of said vacuum chamber into a predetermined value;

a sample electrode for placing a sample in said vacuum chamber;

a plasma generating apparatus;

a high frequency power supply for supplying a high frequency electric power to said plasma generating apparatus;

a high frequency power supply for supplying a high frequency electric power to said sample electrode;

a sampler which, when the forward power of the high frequency electric power supplied to the plasma generating apparatus or the sample electrode is denoted by Pf and when the reflected power thereof is denoted by Pr, samples the power difference Pf-Pr in

every interval of 1 millisecond through 100 milliseconds; and

a controlling apparatus which, when the integration of the power difference Pf-Pr with respect to time reaches a predetermined value, stops the supply of the high frequency electric power.